

The Deep-Sea Isopod *Anuropus branchiatus*, Bedd., and some Remarks on *Bathynomus giganteus*, A. M.-Edw. By Dr. H. J. HANSEN (Copenhagen), F.M.L.S.

[Read 18th December, 1902.]

(PLATE 4.)

I. ANUROPUS BRANCHIATUS, *Beddard*.

A RICH collection of Isopoda was secured by the 'Challenger' and described by F. E. Beddard. In Part II. of his Report (in vol. xvii. 1886) the author asserts with good reason respecting the form *Anuropus branchiatus*, Bedd.: "This genus is quite the most remarkable that was obtained during the voyage; it is represented only by a single individual from deep water (1070 fathoms) in the Western Pacific, off New Guinea." No expedition has met with the animal again. Beddard refers *Anuropus* to the family Cymothoidæ, without further remarks on its position within this very extensive group; he devotes nearly four pages (pp. 152-156) to the description and five figures on pl. vii. He correctly points out that the uropoda have been developed as supplementary respiratory organs, in all respects similar to the pleopoda, and that no trace of eyes is to be found; furthermore, he describes the reduced antennulæ, the antennæ, legs, &c. But his description of the mouth-parts is defective, and the figure (fig. 4) representing these organs is insufficient, wherefore the genus has been to a certain extent a puzzle to later systematic writers.

In 1890 I published a paper: "Cirolanidæ et familie nonnullæ propinquæ Musei Hauniensis" (Kgl. Danske Vidensk. Selsk. Skrifter, 6 Række, naturv. og math. Afd. B. v. iii. (1890) 3, pp. 239-426, tab. 1-10), in which I attempted to bring about some order in the extensive group, which may be named the Cymothoidæ after one of its types. I referred all the animals in question to six families: Cirolanidæ, Corallanidæ, Alciironidæ, Barybrotidæ, Ægidæ, and Cymothoidæ, and these have been adopted by all authors who have since written on the group. In 1895 I attempted, in "Isopoden, Cumaceen und Stomatopoden der Plankton-Expedition" (Ergebn. d. Plankt.-Exped. d. Humboldt-Stiftung, B. II. G. c), to produce an arrangement of the families of the order Isopoda. In order to procure a tolerable

equivalence between the families, I established the group Cymothoidæ, sens. lat., as a family of the same value as the families Anthuridæ, Bopyridæ (Epicarida), &c. The six above-named families were now considered as subfamilies, *Cirolaninæ*, *Corallaninæ*, &c., of the family Cymothoidæ.

In the above-named paper of 1890 I have allowed two-thirds of a page (pp. 254–255) to an extract and critical review of Beddard's description and drawings of *Anuropus branchiatus*. I will here only translate the following lines:—"As a kind of résumé, I can only say that *Anuropus* either, and probably, must belong to my family Cirolanidæ, or that it, if the structure of the mouth should present unknown and deviating features of significance, must be established as the type of a new family." When the arrangement in my Plankton paper is followed, the result will therefore be that *Anuropus* must either be referred to the subfamily *Cirolaninæ*, or established as the type of a new subfamily, *Anuropinæ*, the seventh one of the family Cymothoidæ.

In his very interesting and useful book, 'A History of Crustacea—Recent Malacostraca,' 1893 (Internat. Scient. Series), the Rev. T. R. R. Stebbing adopts my arrangement of the group; but on *Anuropus* he writes (p. 345) that it "may have greater claims to be the type of a distinct family, Anuropidæ, since, in addition to the conversion of the uropods into branchial pleopods, and the absence of eyes, the first antennæ have only two joints, and the very short 'palp' of the maxillipeds consists of a single joint." As to this view, I refer to the following pages. I am not aware that any other author has contributed to the discussion of the systematic position of this aberrant genus.

During a stay in London in July and August 1902, I took the good opportunity to examine the type-specimen of *Anuropus* preserved in the British Museum (Natural History). I am much indebted to Professor F. Jeffrey Bell for the permission to study that interesting animal, and I beg him to accept my sincere thanks. The specimen proved to be rather badly preserved: of the thoracic legs only two were complete (or nearly so); the antennæ and the mandibular palpi were incomplete; of the mouth-parts the three posterior appendages on the left side had been removed, and could not be found in the collection. I did not remove by dissection any of the remaining mouth-parts; the shape and structure of the mandibles could be studied without much difficulty. In order to see the maxillula and the maxilla I have

bent the maxilliped (and the maxilla) backwards, but the figures in question (Pl. 4. figs. 4 & 5) have been drawn without camera. My figures of the mouth-parts show all the details necessary for the purpose: only the basal part of the maxillula has been omitted; it could not be examined without undertaking a dissection, but fortunately it is of slight or no importance in this connection. I must add that I do not deem it necessary to redescribe every detail, or to draw a complete set of new figures. As to the thorax and abdomen, I refer the reader to the description and figures in Beddard's work, confining myself essentially to some remarks, additional and critical, and figures of two legs. For comparison with the *Cirolaninæ* (and *Alcironinæ*), the student is constantly referred to my above-named paper published in 1890.

Head.—It is proportionately rather short and narrow, but deep: in Pl. 4. fig. 1 it is shown obliquely from in front and somewhat from below; in fig. 2 from below and somewhat from behind. On the front side it presents a rather deep and exceedingly high transverse groove (*a*), which tapers somewhat towards the middle line, where it is interrupted in the upper half by a narrow vertical keel, and in the lower half by the frontal plate. In the groove the antennulæ (*c*) and the antennæ (*d*) are situated. The groove is limited below by a thick transverse wall (*e*), which at the middle turns upwards, constituting the upper part of the frontal plate; the lower part of this plate is not marked off laterally from the wall by any suture or impression, while in the *Cirolaninæ* and *Alcironinæ* the plate is always sharply defined on all sides. The clypeus (*f*) is situated below the wall and marked off from it by a deep, somewhat sinuate transverse impression, without any real suture.

Antennulæ (Pl. 4. fig. 1, *c*).—These are exceedingly thick and moderately short, reaching slightly beyond the lateral margin of the head, and each consisting only of two joints. The basal joint is shorter than thick, and I am inclined to suppose that it is homologous with the two proximal joints of the peduncle in many *Cirolaninæ*; the distal joint would then correspond with the third joint of the peduncle and the flagellum together—but I cannot prove the correctness of this supposition.

Antennæ (Pl. 4. fig. 1, *d*).—These consist, according to Beddard, of a four-jointed peduncle and a nine-jointed flagellum. In the specimen the peduncle has been preserved; it is considerably

longer than the antennulæ, slender, the two proximal joints rather short, the third a little longer and the fourth a little shorter than the two proximal ones together.

Labrum (*g* in Pl. 4. figs. 1 & 2).—It is somewhat smaller than in *Eurydice* and other *Cirolaninæ*, but not very different in shape; it is about twice as broad as long, with the basal margin slightly concave, the distal rather flatly convex.

Mandibles (*h* in Pl. 4. figs. 1 & 2).—These are robust in their whole length, a little narrower at the base than at the middle. They show on the whole considerable resemblance to those in *Cirolana*, but still differ in several features; and nearly all the differences may be considered as reductions from the type of the *Cirolaninæ*. About their proximal two-thirds are directed obliquely forwards and somewhat inwards and downwards; the distal third turns strongly towards the middle line; their direction presents therefore a stage intermediate between those in *Cirolana-Eurydice* and *Alcironinæ*. Their condylus outside the lateral margin of the labrum is short. The cutting-edges are less produced, and therefore shorter than in *Cirolana-Eurydice*, meeting both above and behind the labrum as in these genera; the posterior angle is acute and very little produced in both mandibles, but the two other teeth seen on the cutting-edges of the genera mentioned are not present in *Anuropus*. The lacinia mobilis (Pl. 4. fig. 3, *l*) is rudimentary; the margin between the cutting-edge and the molar process (Pl. 4. fig. 3, *m*) is long, slightly convex, and—as far as could be observed without dissection—only adorned with a number of very short and thin setæ (comp. *Cirolana*). The molar process (Pl. 4. fig. 3, *m*) is moderately large, compressed, oblong, shaped nearly as in *Eurydice*, but only with fine and short setæ along the anterior margin, and firmly united with the mandible (in *Cirolana-Eurydice* it is movably articulated to the body of the mandible), not even marked off by any suture. Of one of the palpi two joints (*i* in Pl. 4. figs. 1 & 2) have been preserved; the second joint is shorter than in *Cirolana-Eurydice*.

Maxillulæ (first pair of maxillæ, auctorum) (Pl. 4. fig. 2, *l*; fig. 4).—These agree closely with those in *Eurydice*. The lobe of the first joint (*l*¹) is well developed, distally rather robust, with three long, plumose spines. The lobe of the third joint (*l*³) is very broad, its oblique terminal margin has a number of partially thick spines. (The basal portion of this appendage could not be studied without a dissection.)

Maxillæ (second pair of maxillæ, auct.) (Pl. 4. fig. 2, *m*; fig. 5).—These are somewhat shorter than the maxillulæ, but yet rather large. They differ from those in *Eurydice* only in one point: the lobe of the third joint (l^3) is a single moderately broad plate, while in *Cirolana-Eurydice* it is divided into two parallel lobes, together as broad as, but proportionately longer than, that in *Anuropus*. The lobe of the second joint has four long and strong, plumose setæ, the lobe of the third joint four shorter setæ.

Paragnatha (or *hypopharynx*) (Pl. 4. fig. 2, *k*).—These are a pair of plates which are turned strongly outwards; each is a little longer than broad, with the anterior margin rounded. As compared with those in *Cirolana*, they are a little broader and very much shorter, turning considerably more outwards, and without any produced and curved terminal portion.

Maxillipeds (Pl. 4. fig. 2).—These are thick, do not reach the distal end of the outer lobe of the maxillulæ, and they are in other respects very reduced. The basal joint (*n*) and its large epipod (*o*) as developed as in *Cirolana*. The second joint is formed by the fusion of the second and third joints in *Cirolana*; it is moderately short, and does not possess any trace of the lobe (frequently with coupling-hooks) developed in *Cirolana-Eurydice*. The palpus consists in *Cirolana* and closely allied genera of four joints; in *Anuropus* all these have been completely fused without traces of sutures, constituting one large oblong joint, with some short setæ on the lower side near the inner margin; and this joint shows even tolerably the general outline of the four-jointed palpus in the genera mentioned.

Thorax and its Legs.—Figs. 1 and 2 in Beddard's work convey a sufficient idea of the shape of the thorax with its "epimera"; it scarcely needs mention that the suture, drawn in his fig. 2, between the first segment and its epimeron does not exist. The first pair of legs (Pl. 4. fig. 6) are very robust, to a certain degree developed as a prehensile organ; the third joint (the not-developed epimeron considered as the basal joint) is thick, the fourth short and thick, the fifth very short, the sixth rather long and thick; the seventh joint (γ) is nearly claw-shaped, but yet slightly curved, and can be folded inwards along the lower surface of the sixth joint; it terminates in a real claw (*c*), which is exceedingly short, acute. Of the six other pairs of legs only one leg, of the fourth pair, was almost completely preserved, and it agrees in all essential points with the same leg in some species of *Cirolana*; its four distal

joints with a number of short setæ and spines is shown in fig. 7; the seventh joint (?) is only about one-fourth the length of the preceding joint; the claw was broken off, but it can be said with certainty that it must have been very short. Of all the other legs at least one joint and often more joints were absent; but these fifth pairs seem to have differed only in quite unimportant features, for instance as to length, from the fourth pair. Beddard's fig. 2 shows all the legs, but in the text he states that the distal joints of the second pair were missing; the figure is moderately good, but it must be mentioned that the terminal joint of the legs is too long.

Abdomen and its Legs.—The abdomen has been moderately well drawn in Beddard's fig. 1. It increases gradually somewhat in breadth from the base to the middle of the sixth segment; the five proximal segments are subequal in shape, and similar to the same segments in the males of some species of *Eurydice*, with the exception that in the last-named genus these segments do not increase in breadth posteriorly. The sixth segment is a large shield, nearly circularly rounded on the sides and behind, without hairs or spines on the posterior margin.

The five pairs of *pleopods* are shaped about as in *Cirolana*; both rami of the same pair and the rami of all pairs are similar in quality and without marginal hairs. In the first pair the inner posterior angle of the peduncle has a series of more than ten coupling-hooks; such hooks are also present on the second, third, and fourth, but not on the fifth pair. The *uropods* originate close behind the anterior angle of the segment on its lower side near the lateral margin; the outer edge of the peduncle protrudes beyond that margin. The peduncle is very small, very short, and rather narrow; the postero-interior process is short. The inner ramus reaches nearly to the hind margin of the abdomen; it is oblong-ovate, a little longer and a little narrower than the outer ramus; both rami are similar in quality to those of the pleopods. It has been pointed out by Beddard that the uropods have a respiratory function as the rami of the pleopods, and are concealed beneath the last abdominal segment.

Length and Sex.—The specimen measures, as stated by Beddard, 70 mm. in length. It has no trace of marsupial lamellæ or of "appendix masculina" on the second pair of pleopods. I forgot to look for genital processes on the last thoracic segment, and

I am therefore unable to state with certainty whether it is an immature female or perhaps an immature male.

Position in the System.—The preceding description (with the figures) shows that my statement in 1890—which has been quoted above—on the probable position of this aberrant genus is tolerably correct. After the examination of the type I am now much better acquainted with the genus, having studied all features—especially the mouth-parts and the terminal part of the thoracic legs—of any importance to a final judgment as to its relationship; and besides I am familiar with all the subfamilies and main genera of the Cymothoidæ. But in spite of this knowledge, I am still rather uncertain whether I shall refer the animal to the *Cirolaninæ*, or establish it as a type of a new subfamily, *Anuropinæ*. It is easily seen that it is very distinct from four of the subfamilies—*Corallaninæ*, *Barybrotinæ*, *Æginæ*, and *Cymothoinæ*, and that its mouth-parts show a much closer resemblance to those of the *Cirolaninæ* than to the *Alcironinæ*, only the moderately oblique direction of the mandibles and the strongly-reduced maxillipeds without lobe from the second joint pointing towards features met with in the last-named subfamily. The structure of the legs with their very short claws agrees essentially with that in *Cirolana*. The shape, position, and respiratory function of the uropods is an adaptation to be compared with the supplementary branchiæ in the genus *Bathynomus* which belongs to the *Cirolaninæ*, and that character is therefore of secondary value; the disappearance of the eyes is also certainly an adaptation and of secondary importance, being at most only of generic value. The reduction of the antennulæ is very interesting; it is certainly an excellent generic character, but scarcely an important one for a subfamily, and nearly all the features in which the mouth-parts differ from those of the *Cirolaninæ* sens. strict., and especially from *Eurydice*, seem to be mere reductions. While the maxillulæ agree closely with those of *Eurydice*, the maxillæ differ as to one not very important point; and the mandibles, though showing some reductions and a more oblique direction, agree moderately well with those in *Eurydice* in essential points—the distal breadth of the mandible, the breadth of the cutting-edge, the shape of the molar process. The maxillipeds are much more reduced than in *Cirolana*—*Eurydice*; the paragnatha are much shorter, rounded distally, &c.

My reason for proposing to establish *Anuropus*, Bedd., as the type of a new subfamily, *Anuropinæ*, is that *the differences between its mouth-parts and those of the Cirolaninæ* are so pronounced, that it may be considered a *practical arrangement* to remove *Anuropus* from the last-named subfamily, which will now be a much more uniform and more sharply-defined group. But it is possible that in the future some form may be discovered which will prove to be a transition between *Eurydice* and *Anuropus*; and after such a discovery the subfamily *Anuropinæ* ought to be withdrawn. It is scarcely necessary to compile from the description of the mouth-parts a conspectus similar to that of the *Cirolaninæ* on pp. 310-311 of my earlier paper; when in the future many new forms of the various subfamilies have been studied, at least a few alterations in some of my earlier diagnoses of the subfamilies will most probably be necessary, and every student of the family can then easily compile a diagnosis of the *Anuropinæ* from my description and the drawings.

II. BATHYNOMUS GIGANTEUS, *A. Milne-Edwards.*

In July this year (1902) Professor E. L. Bouvier published a very valuable and splendidly illustrated work: "Les Bathynomes," par Alphonse Milne-Edwards et E. L. Bouvier (Reports on the Results of Dredging under the supervision of Alexander Agassiz, by the U.S. Coast Survey Steamer 'Blake': Memoirs Mus. Comp. Zool. at Harvard College, vol. xxvii. no. 2, pp. 128-175, pls. 1-8). Bouvier states in a footnote that he had found an earlier sketch (consisting of three large drawings) treating of *Bath. giganteus* among the papers of the late Prof. Alph. Milne-Edwards; but it is evident that at least the main part of the work has been done by himself. He has produced a very detailed report on the external structure of one American specimen of *Bath. giganteus*, A. M.-Edw., and of the two hitherto known specimens of *B. Döderleini*, Ortm., and he discusses very thoroughly the systematic position of this exceedingly interesting genus. The Zoological Museum in Copenhagen has obtained by exchange one specimen of *B. giganteus* from the Museum in Calcutta; it was captured in the Bay of Bengal, "off Goa coast, 740 fathoms." Working on *Anuropus*, I thought it practical besides to look at the external structure of our specimen of

Bathynomus. I must begin with the statement that I can contribute only two or three small additional and a few critical remarks to the beautiful and exhaustive treatment by Bouvier, to which the reader is referred.

The specimen seen by me is an immature female, measuring 193 mm. in length, with five pairs of rudimentary marsupial lamellæ, the longest of which, the fourth, measures only 7.5 mm. in length and 4.5 mm. in breadth. A comparison with the figures in Bouvier's work shows that it belongs to *B. giganteus*, and does not even present any deviating feature in the "epimera," the abdomen, &c., worth mentioning.

Dorsal Organ on the Head.—In the figure on pl. 1 in the French work, showing the animal from above, is seen a whitish spot in the central line of the head at a short distance from its posterior margin. A closer examination shows that this spot must be a kind of organ. The brownish chitine around the whitish spot (Pl. 4. fig. 8) is glabrous, without the numerous irregular impressed points adorning nearly the whole surface; the spot itself is slightly arched, presenting a small central oblong impression, and on each half a very small group of very fine impressed dots. I know nothing of the nature of this organ. It is probably homologous with the curious organ pointed out on the upper surface of the head of *Anaspides Tasmaniae*, G. M. Thoms., by W. T. Calman (Calman, "On the Genus *Anaspides*, &c.," Trans. Roy. Soc. Edinburgh, vol. xxxviii. part iv. 1896, p. 788). I have searched for this organ on a few species of *Cirolana*, and found a vestige of it in *Cir. borealis*, Lilljeb. I hope in the near future to publish a note on the two organs in various Malacostraca.

Antennulæ.—Bouvier has made an interesting discovery: he points out the existence of an accessory ramus originating from the third joint of the peduncle of the antennulæ, and consisting of only one very small joint. I can only confirm his description. I have now looked in vain for an accessory ramus in some species of *Cirolana*; so far as I know, it has not been observed in any other Isopod, but it is well developed in *Apeudes* and the major part of *Amphipoda Gammaridea*. The short setæ on the joints of the flagellum mentioned by Bouvier (p. 144) are the sensory (olfactory) organs.

Antennæ.—The French author writes (p. 144):—"Les pédoncules antennaires (pl. iv. fig. 7), comme dans la plupart des

Isopodes, se composent de 6 articles. Le premier est immobile, interrompu en dessus à la base des antennules, et forme en arrière un prolongement triangulaire entre les parties latérales du clypeus et la partie inférieure de la région céphalique. Le deuxième anneau est mobile . . ." These statements and the figure mentioned are partly incorrect. In 'Isopoden, Cumaceen, und Stomatopoden der Plankton-Expedition' I have written (p. 4): "Bei *Asellota* hat der Stiel der Antennen 6. *Glieder* (ein Charakter, der bei *Mysidæ veræ* sich wieder findet) und oftmals ein rudimentäres Squama auf dem 3. Gliede Bei allen andern Isopoden . . . ist der Stiel der Antennen höchstens 5-gliedrig (das 1. Glied ist mit dem Kopfe vereinigt), ohne Squama, . . ." But I discover now that *Bathynomus* disagrees with these statements of Bouvier and of myself: the antennal peduncle consists certainly of *six joints, but all are movable*. What has been considered by Bouvier as the first, immovable joint is a portion of the head (Pl. 4. fig. 9, *a*), not marked off posteriorly as in his fig. 4; furthermore he has overlooked the real first joint. This joint (Pl. 4. fig. 9, *1*) is a rather narrow longitudinal strip of hard chitine, situated on the lower side of the head outside the second joint; when I turned the peduncle of the antennæ backwards and inwards, this basal joint was very conspicuously moved, and the faculty of movement indicates the presence of an articular membrane between the hard strip and the skeleton of the head. My fig. 9 shows an anteriorly narrow, posteriorly broad articular membrane between this basal joint and the second one (*2*), and besides a well-developed articular membrane between the posterior margin of the second joint and the head. The position of the first joint is quite as in *Eurycope* (comp. fig. 3 *b* on pl. 20 in my report on the Crustacea in 'Dijmphna-Togtets zoologisk-botaniske Udbytte,' Kjöbenhavn, 1887) and other *Asellota*, but it is proportionately considerably shorter. The third and following joints have been correctly described and figured by Bouvier.

After the discovery of the basal movable joint in *Bathynomus*, I examined the antennæ in *Cirolana elongata*, H. M.-Edw., *C. borealis*, Lilljeb., and *C. Cranchii*, Leach (three species representing different groups of that extensive genus), and I was now able to find the same basal joint at the outer margin of the following one. It is especially well developed in *C. elongata*, but also distinct in the two other species; when the lower surface of

the head is quite dry, and the peduncle is bent backwards and somewhat inwards, it is lifted out of a depression at the base of the antennæ.

Maxillulæ (first pair of maxillæ, auct.).—Bouvier writes (p. 148): “Elles ressemblent beaucoup aux mâchoires des Cirolanes qu’a figurées M. Hansen, mais présentent trois articles basilaires (1, 2, 3), dont deux s’articulent avec la petite lacinie (*l, i*); il est probable que ces deux articles correspondent à celui que M. Hansen désigne avec no. 1.” His fig. 6 on pl. 5 represents the basal portion of the appendage and is certainly correct, but his interpretation of the parts is incorrect. The joint considered by Bouvier to be the second is in reality the first one: it is proportionately long and *is articulated with the skeleton of the head*; an examination of a *Cirolana* or, still better, of a large specimen of *Chiridothea* will easily prove this fact. The part regarded by Bouvier as the first joint is the basal section of the lacinia proceeding from the anterior and lower side of the elongate first joint, and it is, besides, distant from the skeleton of the head. The result is that the first joint of Bouvier must be put aside, and we have then the three joints described by me in the paper on the Cirolanidæ (1890), in ‘Dijmphna-Togtet’ (three figures on pl. 20), and elsewhere. That my view respecting the three joints is correct is easily proved by a careful examination of the constituting elements in the same appendage of a large *Aapseudes* or an *Anonyx*, in which genera a two-jointed “palp” originates from the outer side of the third joint; it is still better proved by the study of the maxillulæ in certain larval stages of *Euphausia*, in which not only a palpus but also an exopod (which again disappears during the development) projects from the outer margin of the third joint.

Maxillæ (second pair of maxillæ, auct.).—Bouvier has a figure which is very similar to mine of certain species of *Cirolana*, but as to the interpretation of the chitinous elements he differs largely. It was impossible to prove the correctness of my view in the paper on the Cirolanidæ &c. without producing a minute description of the parts in question, and besides adding a description with figure of the maxilla of a *Mysis*. I think it to be out of place here, and, besides, I hope in the near future to work out a paper on the appendages in Crustacea, lower Insects, &c. I will only mention that in *Mysis* an exopod proceeds from the joint considered by me to be the third, but by Bouvier counted

as the second; furthermore, the two laciniae considered by me to belong to the same third joint are developed in a similar way in *Mysis*, which besides possesses a palpus, consisting of a fourth and a fifth joint, not existing in the Isopoda. The presence of both this palpus, of the two narrow lobes mentioned, and of the exopod in *Mysis*, proves that the outer one of the narrow laciniae in *Bathynomus*—and other Isopods—cannot, with Bouvier, be regarded as the exopod. A study of the constituting elements of the maxillae in Cumacea, in larval stages of Peneidæ, &c., will give the same results (comp. my preliminary morphological paper in 'Zool. Anzeiger,' 1893).

Maxillipeds.—I have nothing to add to the detailed and careful description of Bouvier. But in reference to the free "joint" projecting from the upper side of the second joint at its distal end, he says (p. 151) that "M. Hansen regarde [cet article] comme une lacinie mais que nous tenons plutôt pour un expodite (*ex*), dont la base d'attache se serait rapprochée de la ligne médiane, en passant par dessus l'endopodite." That the joint in question is a lobe separated by an articulation from the second joint of the maxilliped is proved by comparison with other Malacostraca. In *Bathynomus*, *Cirolana*, and *Chiridothea* (*Glyptonotus*) the "joint" is marked off by an articulation; in *Eurycope gigantea* ('Dijmphna-Togtet . . .' tab. 20. fig. 3 *g*) it is much larger, but not at all marked off at the base, proving itself to be a lobe from the second joint of the maxilliped, and it is developed in a similar way in many other Isopoda (comp. G. O. Sars, 'Crustacea of Norway—Isopoda'). In most *Amphipoda Gammaridea*, for instance in *Socarnes* ('Dijmphna-Togtet . . .' tab. 21. fig. 5 *b*), the same lobe from the second joint has been developed on the same place and marked off by an articulation, but, besides, a lobe (in *Socarnes* much larger than the preceding one), not defined by an articulation, has been developed from the third joint. In *Mysis* the lobe from the end of the second joint is rather short but yet plainly seen, and besides a large exopod projects from the outer side of the same joint near its base. Therefore I must maintain my earlier interpretation, which, for the rest, is not original, being set forth by other authors before the publication of the Crustacea in 'Dijmphna-Togtets zool.-bot. Udbytte.'

Abdomen.—The French author writes on p. 172:—"Ils nous semble que la pièce caudale, avec sa forme semi-circulaire et ses

fortes dents postérieures, permet plus sûrement de distinguer les Bathynomes des Cirolanes, d'autant que cette pièce est dépourvue des soies marginales qu'on observe dans la plupart des Cirolanes, si non chez toutes." But *Bathynomus giganteus* is not without setæ at the posterior margin of the last abdominal segment. The large and beautiful figure on pl. 2 in the French work, of the animal seen from below, shows fine and short hairs between the marginal processes, and this is quite correct. On the lower side along the margin between the processes mentioned is observed a fine transverse furrow, in which a row of thin plumose setæ are inserted; the longest of these setæ I have found between the fourth and the fifth process—the median one taken as the first—and some of them measured about 1.5 mm. in length. A large number of these submarginal setæ have been broken off in our specimen, but on a closer inspection the furrow mentioned and some of the setæ are everywhere distinctly seen. It may be added that setæ at the hind margin exist in all species of *Cirolana*.

Pleopoda.—In 'Zoologischer Anzeiger,' nos. 420–421, 1893, I wrote (§ 13): "Es folgt aus . . . dass man drei Glieder im Stamm von allen gespalteten Gliedmassen bei den Crustaceen als ein primäres Verhältnis annehmen muss"; and I mentioned the existence of these three joints in the thoracic appendages of the Phyllopoda, in the natatory limbs of *Argulus*, in the antennæ and mandibles of certain pelagic Copepoda, in the antennæ and the thoracic legs of *Nebalia*, in the antennæ of *Mysidæ veræ* and of some Isopoda, in the maxillulæ and maxillæ of nearly all orders of Malacostraca. Now Bouvier writes (p. 154) on *Bath. giganteus*: "Les pléopodes (pl. 6. figs. 1–5, 7) ont conservé la structure normale des appendices des Crustacés, en ce sens qu'il se composent (figs. 1, 4) d'une hampe ou sympodite de trois articles, et de deux lames terminales, endopodite et exopodite"—and next he describes these parts. The gigantic animal is an excellent object for the study of the joints in the sympods of pleopoda, while such joints in animals of normal size are difficult to discover and especially difficult to judge of with certainty. I have examined the pleopoda of *Bathynomus*, and can only confirm Bouvier's interesting discovery: it is the first time that three joints have been pointed out in the peduncle, the sympod, of abdominal legs. Bouvier says that the interior lobe of the sympod "est cilié de puissantes soies," and they are drawn

in his fig. 1 on pl. 6, representing the first left pleopod. I will add that these setæ are the coupling-hooks met with in *Cirolana* and most other Isopoda; in *Bath. giganteus* the anterior hooks are moderately long, the posterior ones exceedingly long, and at least the posterior ones have their apical part so much altered, that I doubt whether they can really be used as hooks coupling together the two peduncles of the same pair. These subsetiform hooks are found, as in *Cirolana*, on the four anterior pairs, but not on the last pair of pleopods. On the shape and structure of the pleopods with their supplementary branchiæ, the reader is referred to the exhaustive account of the French author.

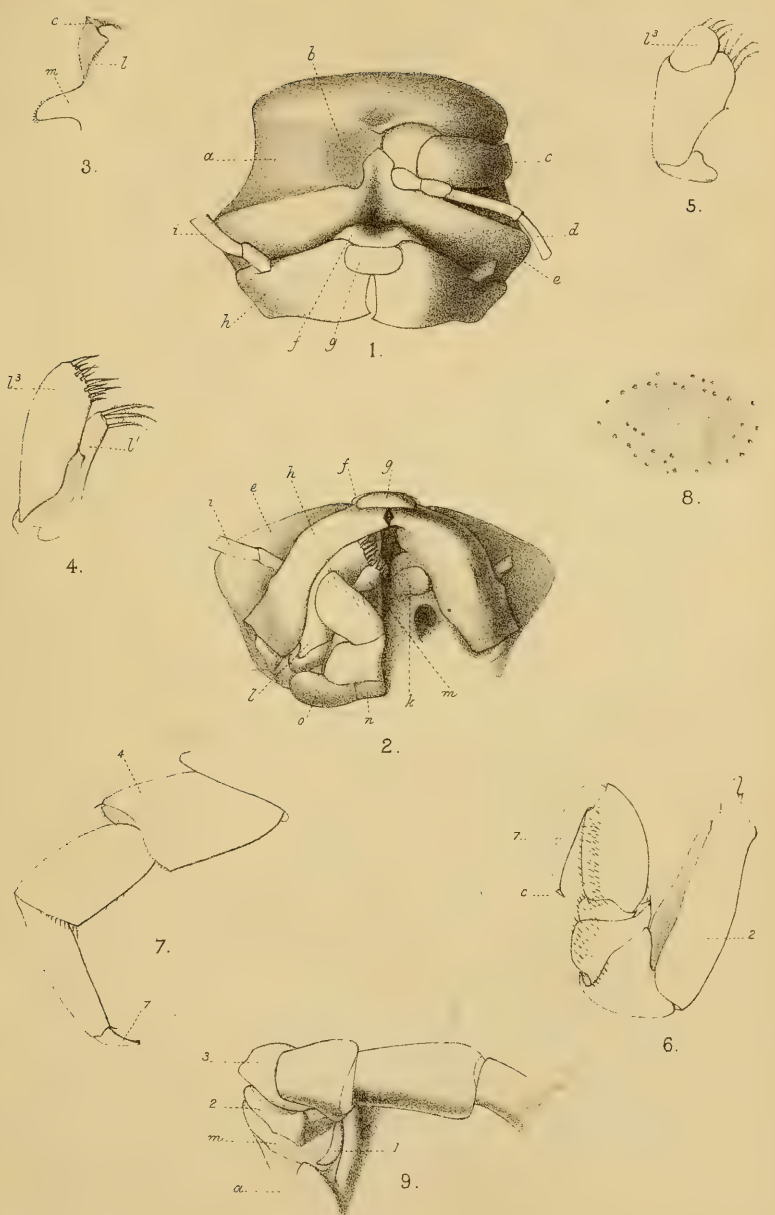
EXPLANATION OF PLATE 4.

Figs. 1-7. *Anuropus branchiatus*, Beddard.

- Fig. 1. Head from in front and somewhat from below, $\times 4$. *a*, transverse groove; *b*, place of insertion of the right antennula; *c*, left antennula; *d*, left antenna; *e*, transverse wall below the groove; *f*, clypeus; *g*, labrum; *h*, mandible; *i*, mandibular palpus, the third joint broken off.
- Fig. 2. Head from below and somewhat from behind. *e*, transverse wall; *f*, clypeus; *g*, labrum; *h*, mandible; *i*, mandibular palpus without its third joint; *k*, left wing of the paragnatha; *l*, maxillula; *m*, maxilla; *n*, basal joint of the maxilliped; *o*, epipod from the basal joint.
- Fig. 3. Distal part of the left mandible from below and partly from the inner side. *c*, cutting-edge; *l*, rudimentary lacinia mobilis; *m*, molar process.
- Fig. 4. Right maxillula from below, the basal part omitted. *l*¹, lobe from the first joint; *l*³, lobe from the third joint.
- Fig. 5. Right maxilla from below. *l*³, lobe from the third joint.
- Fig. 6. Right leg of the first pair, from below, nearly $\times 4$. *2*, second joint (the first joint fused with the thorax); *7*, seventh joint; *e*, claw.
- Fig. 7. Distal part of the right leg of the fourth pair, from below, $\times \frac{3}{2}$. *4*, fourth joint; *7*, seventh joint; the claw has been broken off.

Figs. 8, 9. *Bathynomus giganteus*, A. M.-Edw.

- Fig. 8. Portion of the upper surface of the head, with the organ surrounded by glabrous chitine without impressed points, $\times 3$.
- Fig. 9. Basal part of the left antenna, from below and somewhat from the side, scarcely $\times 3$. *1*, first joint; *2*, second joint; *3*, third joint; *a*, skeleton of the head; *m*, articular membrane.



H.J. Hansen, del.

J.T. Rennie Reid, Lith. Edin^r

1-7, ANUROPIUS BRANCHIATUS, Bead.

8-9, BATHYNOMUS GIGANTEUS, A.M. Edw.